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Erratum: "Formalism for Inclusion of Measured Reaction Cross Sections in Stellar Rates including Uncertainties and its Application to Neutron Capture in the s-process" (2012, ApJL, 755, L10)

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Abstract

The final rate uncertainty factors presented in the original Letter have been calculated using an inappropriate value for the ground-state contribution in some cases. Revised rate uncertainty factors are presented here. Furthermore, the full version of Equation (6), incomplete in the original Letter, is given.

Supporting material: machine-readable table

Revised low-energy neutron capture rates were given in Rauscher (2012a), based on the identification of the ground-state contribution to stellar reaction rates. While the revised rates remain as given in Rauscher (2012a), the assigned uncertainties were incorrectly calculated in some cases. In the calculation of the uncertainty factors $U^*_{\rm new}$ using Equation (11) in Rauscher (2012a) the laboratory contributions $X_{i^{\rm lab}}$ *before* the rate revision was used. Instead, the $X'_{i^{\rm lab}}$ of the new rate *after* revision have to be used. As an alternative to using Equation (11) in Rauscher (2012a) with the new $X'_{i^{\rm lab}}$ it is also possible to still use the previous $X_{i^{\rm lab}}$ but changing Equation (11) in Rauscher (2012a) to

$$U^*_{\rm new} = U_{\rm exp} + (U_{\rm th} - U_{\rm exp})(1 - X_{i^{\rm lab}})\frac{r^*}{(1 - X_{i^{\rm lab}})r^* + r^{i^{\rm lab}}_{\rm exp}}, \quad (1)$$

where r^* is the (theoretical) stellar rate with uncertainty factor $U_{\rm th}$, $r^{i^{\rm lab}}_{\rm exp}$ is the (measured) laboratory rate with uncertainty $U_{\rm exp}$, and $X_{i^{\rm lab}}$ is the (calculated) laboratory contribution to the stellar rate r^* as obtained *before* inclusion of any new information. Above Equation (1) reduces to Equation (11) of Rauscher (2012a) when the actual rate value did not change after inclusion of a new laboratory rate, e.g., when $r^{i^{\rm lab}}_{\rm exp} = r^{i^{\rm lab}}_{\rm th}$. Therefore, the old Equation (11) of Rauscher (2012a) can still be used when only the uncertainties but not the absolute values of the rate changed.

Table 1 gives the corrected values for the uncertainties $U^*_{\rm new}$. They supersede the values given in Table 1 of Rauscher (2012a). Figure 1 provides an updated version of Figure 1 in Rauscher (2012a). It becomes apparent that the overall picture has not changed, with most uncertainty factors being larger than the experimental uncertainties due to the contribution of thermally excited states. As before, the largest uncertainties with $U^*_{\rm new} \gtrsim 1.8$ stem from the semi-empirical values given in KADoNiS (2009), which are based on theory. In comparison to the previously given uncertainties, most uncertainty reductions are found in the region around mass numbers $150 \lesssim A \lesssim 190$ but they still remain larger than the experimental errors.

Finally, it has to be noted that Equation (6) in Rauscher (2012a) is incomplete. The full expression for the effective cross section reads (Holmes et al. 1976; Rauscher 2011, 2012b)

$$\sigma^{\rm eff}(E) = \sum_i \sum_j \frac{2J_i + 1}{2J_0 + 1}\frac{E - E_i}{E}\sigma^{i\to j}(E - E_i), \quad (2)$$

with J_0, J_i being the spins of the target ground state and target excited state i, and $\sigma^{i\to j}(E - E_i)$ being the partial cross section at energy $E - E_i$ from target level i with excitation energy E_i to final level j (following Fowler 1974, partial cross sections at zero or negative energies are set to zero).

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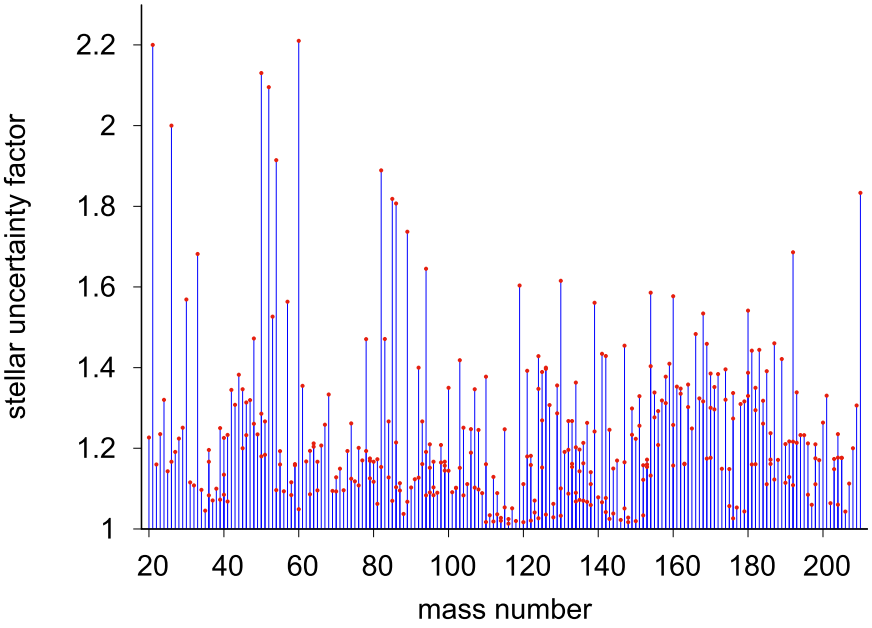

Figure 1. Uncertainty factors $U^*_{\rm new}$ for stellar (n,γ) rates at $kT = 30$ keV.

Table 1
Revised Uncertainty Factors $U^*_{\rm new}$ of Stellar (n,γ) Reactivities at 11 Plasma Temperatures T

Element	Z	A	$kT = 5$ keV $U^*_{\rm new}$	$kT = 10$ keV $U^*_{\rm new}$	⋯ ⋯	$kT = 100$ keV $U^*_{\rm new}$
...						
W	74	182	1.0620	1.0627	⋯	1.6290
W	74	183	1.0625	1.1091	⋯	1.5898
W	74	184	1.0469	1.0471	⋯	1.5772
W	74	185	1.2250	1.2525	⋯	1.5202
W	74	186	1.0829	1.0829	⋯	1.4043
Re	75	185	1.0879	1.0879	⋯	1.3123
Re	75	186	1.1613	1.1613	⋯	1.1613
...						

(This table is available in its entirety in machine-readable form.)

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